RELATIONSHIPS BETWEEN JUMP AND SPRINT FORCE-VELOCITY PROFILES AND PERFORMANCE

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Purpose

To investigate the associations between matched mechanical variables derived from both vertical[1] and horizontal[2] force-velocity-power (FVP) profiling, and the performance outcome variables within squat jump (SJ) and sprint performance.

Method

20 elite male academy rugby league players (age 17.6±0.9 years; height 179.9±6.6cm; body mass 91.2±11.8kg).

- **Data collection:** The participants performed two maximal 40m sprints. Sprints were recorded using a radar gun device (Stalker ATS II), which obtained instantaneous speed-time measurements. Sprint times were determined from the modelled velocity-time data at 2m, 5m, 10m and 20m and maximum velocity (Vmax; m.s-1)[2].
- The participants performed two maximal SJ (~90◦ knee angle) repetitions with 0kg, 20kg, 40kg, 60kg and 80kg. An Optojump was used to record jump height (cm) for each load.
- Body mass relative vertical and horizontal mechanical variables (theoretical maximal values of force (F0) (N/kg), velocity (V0) (m/s), power (Pmax) (W/kg)) and the slope of the F-V linear relationship (Sfv) were calculated[1,2].
- **Data analysis:** Pearson's correlation coefficients (r) assessed the relationship between matched vertical and horizontal mechanical variables (F0 vertical & horizontal, v0 vertical & horizontal, Pmax vertical & horizontal and Sfv vertical & horizontal) and SJ and sprint performance.

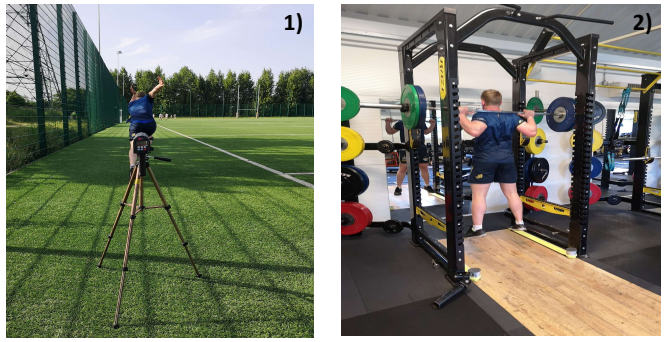

Figure 1&2. Mechanical profiling methods imagery

Results

Table 1. Horizontal and vertical mechanical variables Mean ± SD data.

	F0 (N/kg)	V0 (m/s)	Sfv (N.s/m/kg)	Pmax (W/kg)
HZT variable	7.31±1.04	8.7±0.54	-0.84±0.13	15.9±2.58
VTC variable	31.34±5.15	4.16±1.51	-8.8±4.42	31.51±9.6

Table 2. Performance variable Mean ± SD data.

	Jump height (cm)	2m time (s)	5m time (s)	10m time (s)	20m time (s)	Vmax (m/s)
Performance variable	32.34±11.59	0.82±0.06	1.41±0.08	2.17±0.12	3.49±0.18	8.42±0.49

Table 3. Pearson correlation between matched mechanical variables

	F0 (N/kg)	V0 (m/s)	Sfv (N.s/m/kg)	Pmax (W/kg)
HZT & VTC	r=-0.19	r=0.15	r=-0.25	r=0.34

Table 4. Pearson correlation between HZT mechanical and performance variables.

	HZT-F0 (N/kg)	HZT-V0 (m/s)	HZT-Sfv (N.s/m/kg)	HZT-Pmax (W/kg)
Jump height (cm)	r=-0.42	r=-0.25	r=-0.36	r=-0.43
2m time (s)	**r=-0.98*** **	r=-0.22	**r=0.83 *** **	**r=-0.94*** **
5m time (s)	**r=-0.96*** **	**r=-0.32***	**r=0.78*** **	**r=-0.96*** **
10m time (s)	**r=-0.93*** **	**r=-0.42***	**r=0.71*** **	**r=-0.98*** **
20m time (s)	**r=-0.85*** **	**r=-0.59*** **	**r=-0.59*** **	**r=-0.98*** **
Vmax (m/s)	r=0.17	**r=1.0*** **	r=0.26	**r=0.55*** **

Table 5. Pearson correlation between VTC mechanical and performance variables.

	VTC-F0 (N/kg)	VTC-V0 (m/s)	VTC-Sfv (N.s/m/kg)	VTC-Pmax (W/kg)
Jump height (cm)	r=-0.13	**r=0.47***	r=0.41	**r=0.51***
2m time (s)	r=0.16	r=-0.40	r=-0.27	r=-0.39
5m time (s)	r=0.19	r=-0.40	r=-0.28	r=-0.37
10m time (s)	r=0.17	r=-0.35	r=-0.25	r=-0.32
20m time (s)	r=0.21	r=-0.39	r=-0.30	r=-0.36
Vmax (m/s)	r=-0.05	r=0.17	r=0.12	r=0.16

Note: F0, theoretical maximal force; v0, theoretical maximal velocity; Pmax, theoretical maximal power; HZT, horizontal; VTC, vertical. *P < 0.05, **P < 0.01, ***P < 0.001.

Results Summary

- There was no significant correlation between vertical and horizontal FVP matched mechanical variables (p > 0.05).
- The correlations between vertical FVP variables and sprint performance and between horizontal FVP variables and SJ performance failed to reach statistical significance (p > 0.05).
- Moderate -0.32 to near perfect 1.0 significant correlations (p < 0.05) were found between mechanical and performance variables shifting the importance of separate variables depending on the testing task.

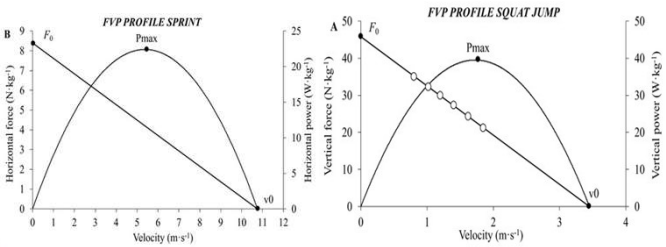

Figure 3 & 4. Example mechanical profiles sprint and SJ[3]

Conclusions

- The absence of significant correlations between the vertical and horizontal FVP profiles suggests that they provide distinctive information about the athlete's mechanical variables.
- The magnitude of the correlations between mechanical variables and sprint performance shifted across the velocity-time curve, therefore performance is determined by separate qualities depending on the distance.
- Whereas, Pmax reported the greatest correlation with SJ height.

Practical Applications

- To ensure specific, accurate and comprehensive characterisation of athletes' physical qualities FVP profiles should be determined with exercises maximal mechanically similarity to the targeted performance task.
- These results will aid practitioners in test selection the prescription and individualisation of training by providing important information as to the most influential variables to develop SJ and sprint performance.

Acknowledgments

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References

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